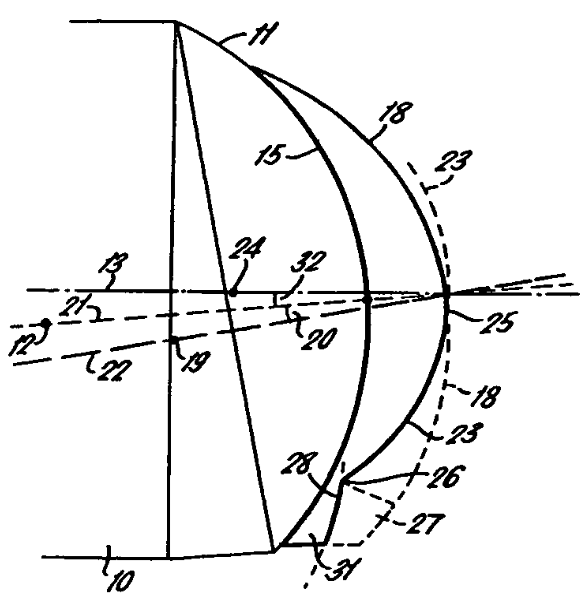
(12) UK Patent Application (19) GB (11) 2 033 101 A

(21) Application No 7927763
(22) Date of filing 9 Aug 1979
(30) Priority data
(31) 78/38986
(32) 2 Oct 1978
(33) United Kingdom (GB)
(43) Application published 14 May 1980
(51) INT CL³ G02C 7/04 7/06
(52) Domestic classification G2J S6AX S6C
(56) Documents cited GB 1367846 GB 1208206 GB 1035877
(58) Field of search G2J
(71) Applicants
Madden Contact Lenses Limited,
Castleham Road,
St. Leonards-on-Sea,
East Sussex,
TN38 9NB.
(72) Inventors
Randolph Evanston Layman
(74) Agents
Boult, Wade & Tennant

(54) Soft bifocal contact lenses

(57) A soft bifocal contact lens is made by mounting the concave back surface 15 of a lens blank 14 on the convex support surface 11 of a lens cutting lathe and cutting a first convex surface 18 on the front of the blank to produce a distance correction lens with a prismatic component. This can be done by offsetting the surface 11 to locate its centre of curvature 12 off the axis of rotation 13 of the lathe. The position of the lens is then adjusted to cut a second surface 23 in the thicker portion of the prismatic lens with the second surface 23 providing a near correction segment which has a prismatic component less than or of opposite sign to that of the distance lens. The blank is then hydrated to make it soft. In a preferred arrangement the distance and near correction lens portions are given equal and opposite prismatic components by rotating the lens by 180° relative to the support surface 11 before cutting the second surface 23. The lens may be truncated top and bottom and provided with a bottom ledge 31 for stabilising in the eye.

FIG. 2.



The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

GB 2 033 101 A

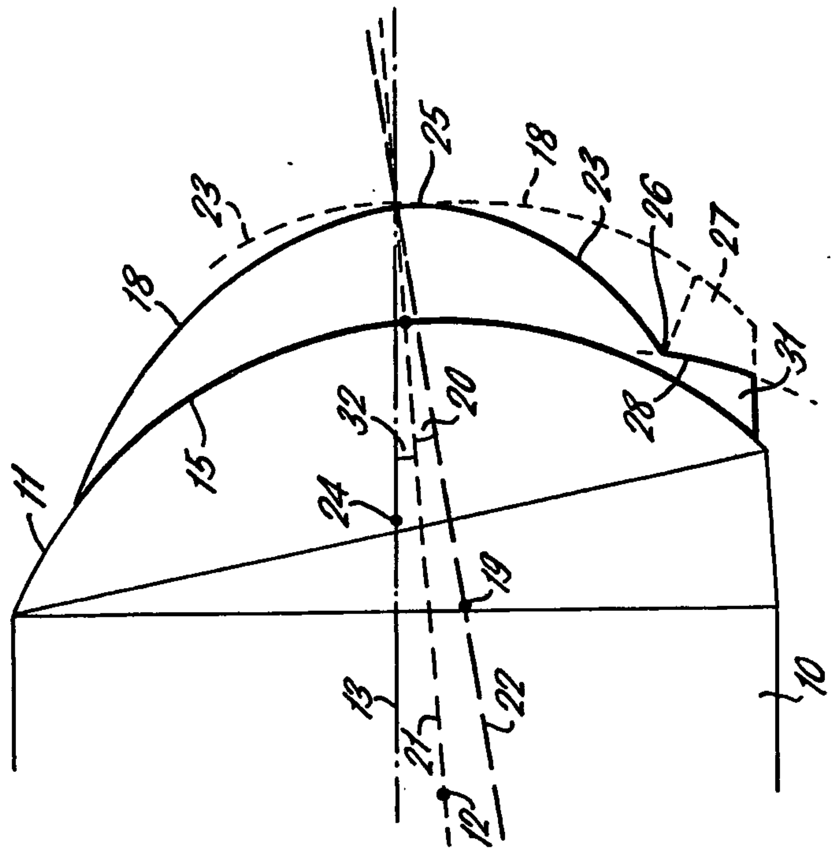

11
18
23
25
26
27
28
31
15
32
20
24
19
13
21
22
12
10

FIG. 2.

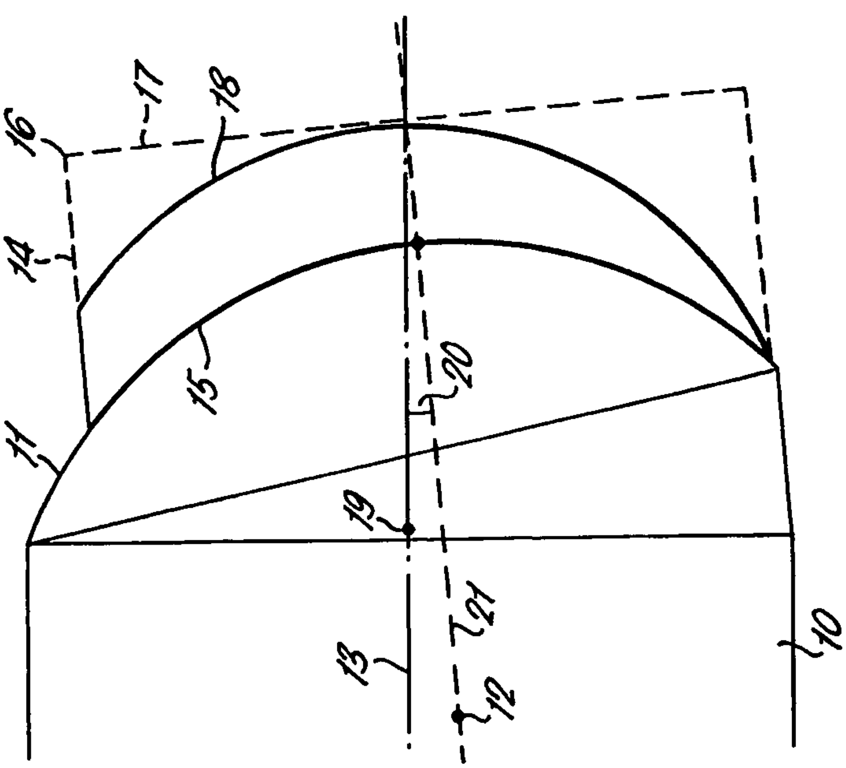

16
17
18
14
15
11
20
19
13
21
12
10

FIG. 1.

FIG. 4.

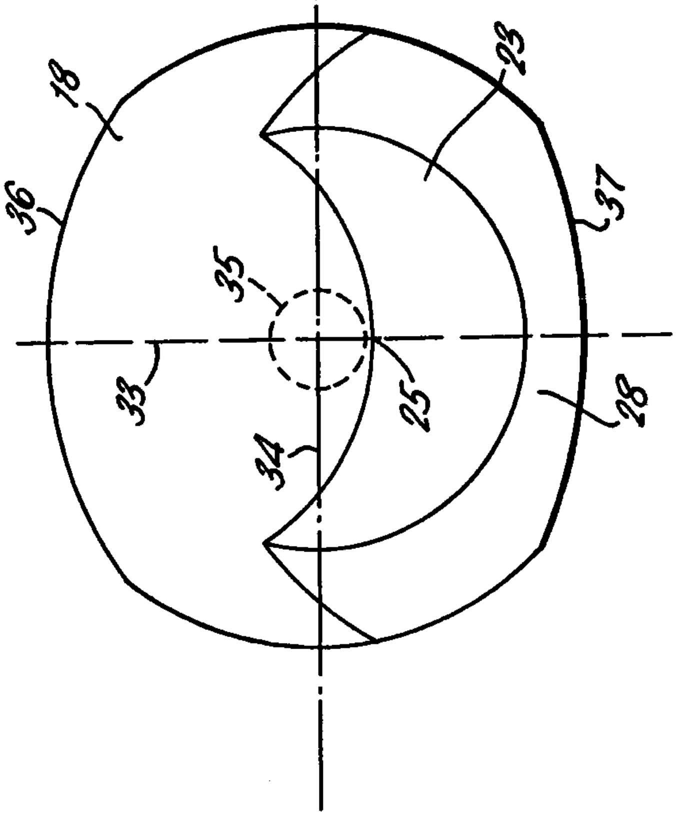
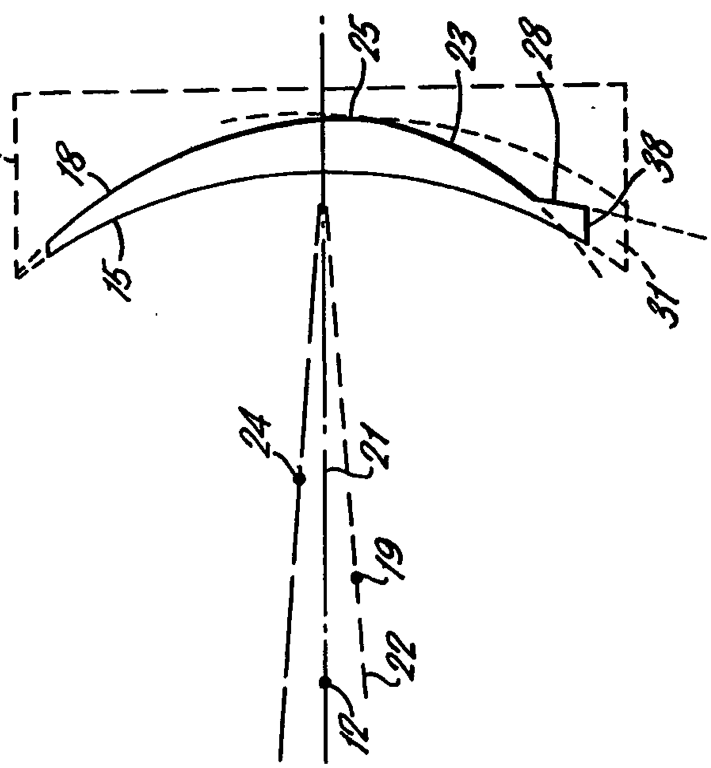


FIG. 3.



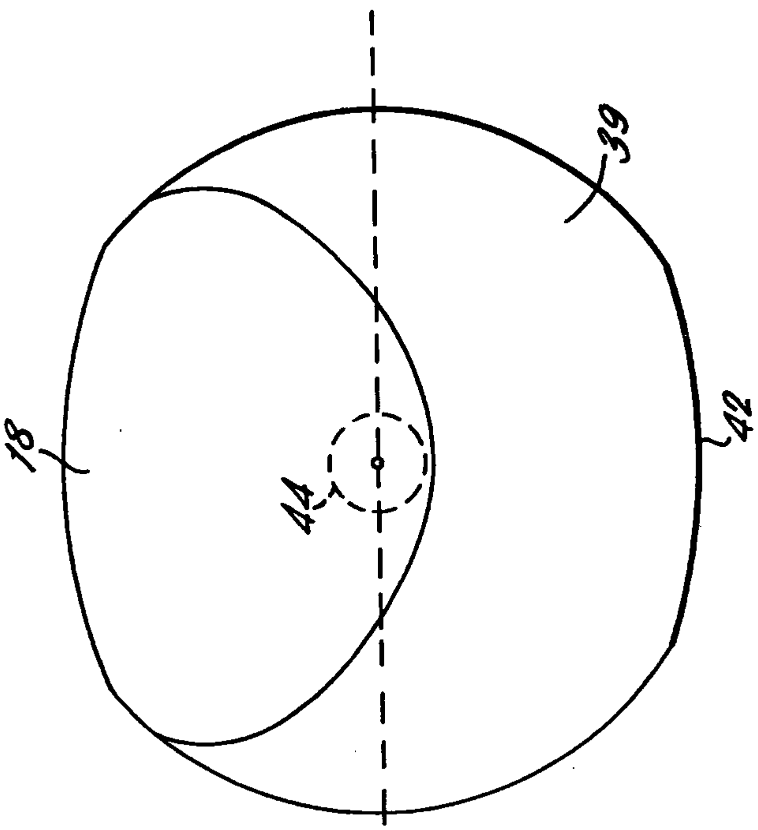


FIG. 6.

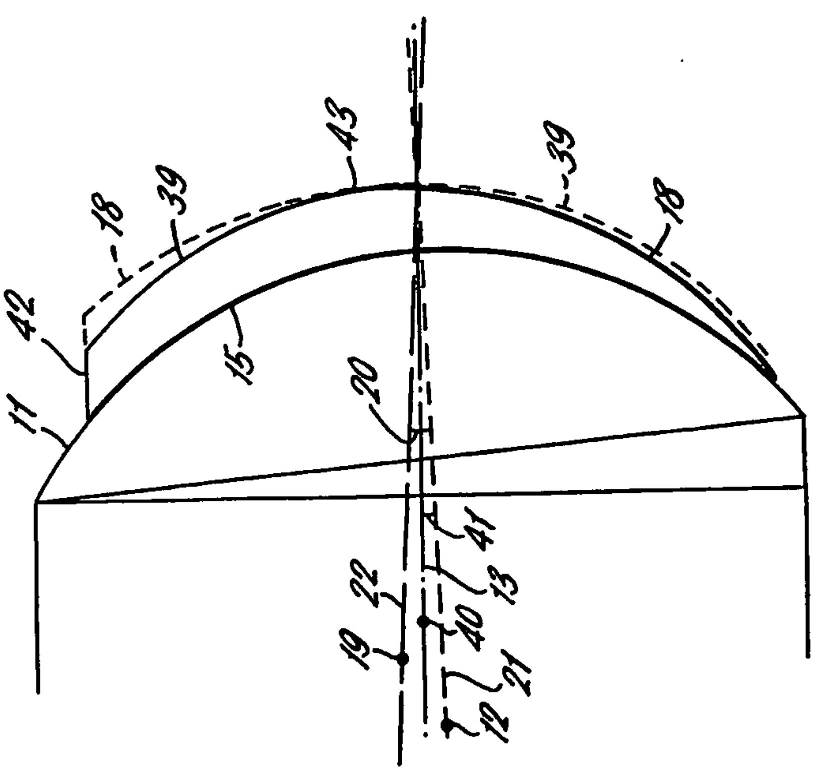


FIG. 5.

SPECIFICATION

Improvements in or relating to contact lenses

This invention relates to contact lenses.

Corneal contact lenses are made either of a hard or a soft plastics material. Soft lenses have certain advantages, in particular they give a much higher degree of comfort enabling the wearer to adapt to them quickly. However, heretofore bifocal contact lenses have always been made of a hard plastics material, because of the problems of obtaining the required optical shaping using a soft plastics material.

Hard bifocal contact lenses have been made by fusing together materials of different refractive indices. This technique cannot be applied to manufacture of soft contact lenses. Soft contact lenses are produced using a plastics material which can be softened by hydration, the lens shape being formed while the material is hard before being hydrated. Although materials with different refractive indices can be employed, it has not yet been found possible to fuse materials which will remain constant in hydration because of the differing linear expansions during hydration of the different materials.

According to this invention, a method of manufacturing a bifocal contact lens of a soft plastics material using a blank which is cut and polished before hydrating to render it soft comprises the steps of cutting and polishing the back face of the lens blank to form a spherical concave surface, rotatably mounting the blank for cutting the front surface with rotation of the blank about a predetermined axis to form a first convex lens surface with the line from the centre of curvature of this surface to the centre of the blank being at a first angle to the line from the centre of curvature of the back face to said centre so that the resulting lens has a first prismatic component, cutting the front surface to form said lens, adjusting the position of the blank relative to the axis of rotation to set it for forming a second spherical convex lens surface on the front face with the position of the blank such that the line from the centre of the curvature of the second convex surface to said centre of the blank is at a second angle to the line from the centre of curvature of the back face to said centre of the blank so that said second lens surface can be formed over a thicker part only of said lens and form a lens segment having a second prismatic component, said second angle being smaller than or of opposite sign to said first angle so that said second prismatic component is smaller than or of opposite sign to said first component, and then cutting said second sperical convex lens surface over said part of the front surface to form said segment and subsequently hydrating the blank to render it soft.

It will be appreciated that said second angle is considered to be of opposite sign to said first angle when the line from the centre of curvature of the second concave surface to said centre of the blank and said line from the centre of curvature of the first surface to the centre of the blank are on opposite sides of the line from the centre of curvature of the back surface to the centre of the blank.

With the technique described above, a blank can readily be formed with the required two optically different lens portions to provide a bifocal contact lens. The method of the invention employs the usual contact lens blank comprising a thick disc or short cylinder of the plastics material in the unhydrated state. The concave surfaces cut on the front surface of a blank normally require to be polished after cutting to produce the necessary good optical finish. As usual for soft contact lens manufacture all the cutting and polishing steps are performed before hydrating the lens to render it soft. With hydration, the material of the lens normally expands by 30 percent or more and accordingly its expansion is accounted for in calculating the desired shape of the lens in the unhydrated state so that once hydrated the finished lens meets the intended prescription.

Normally the lens segment produced in performing the method of the invention provides a near segment for the contact lens, that is to say a segment for near vision, e.g. reading. Thus, conveniently, the contact lens is formed so that its lower edge adjacent said lens segment provides a ledge and is truncated to a radius greater than the radius of the blank, so that the contact lens can be stabilised in the eye with the ledge at the lower edge resting on the lower eyelid. In this way not only is the correct orientation of the lens in the eye ensured, but also, because of the action of the lower eyelid on the ledge at the lower edge of the lens, downwards deflection of the eyeball causes the lens to be moved upwards relative to the eye so that the near segment then covers the pupil. Thus, the wearer of the lens can transfer from normal vision through the distance portion of the lens to near vision through the segment simply by glancing downwards.

In one preferred example of the invention, said first and second angles are substantially equal and of opposite sign, so that said first and second prismatic components are of substantially equal value but opposite sign. References throughout this Specification to the "prismatic component" of either the lens formed by said first convex surface, or said lens segment, refer to the prismatic component of the lens portion relative to the axial line through the centre of the complete contact lens and the centre of curvature of the back surface of the lens.

In the arrangement where said first and second angles are substantially equal and of opposite sign, said second spherical convex lens surface may be cut into said thicker part of said lens so that the lower limit of the second surface is spaced from the adjacent lower edge of the blank and a thicker portion of the contact lens may be formed at the lower edge thereof to provide said ledge. In this way, the overall thickness of the contact lens along the axial line referred to above can be reduced, as will become apparent from the description of examples of the invention later herein. Furthermore, the method may include the further step of cutting a further spherical surface portion on said front surface between said lower limit of the second surface and the edge of the blank with the radius of curvature of said further surface greater than the

radius of said second surface so that the thickness of the contact lens behind said further surface increases towards said lower edge leaving said thicker portion of the contact lens at the lower edge thereof.

In an example of this arrangement of the method, said first and second surfaces may be cut to have prismatic components of opposite sign and not greater than 5 dioptres. Preferably the components are not greater than 3 dioptres and in a particular example the components are about 2 dioptres.

In an alternative example of the invention, said second angle may be less than said first angle but of the same sign, i.e. on the same side of the line from the centre of curvature of the back face to the centre of the blank, so that said second prismatic component is less than but of the same sign as said first component. This arrangement may be employed conveniently especially for contact lenses of relatively low corrective powers. Conveniently, said first prismatic component may be about 5 dioptres and said second component between 2 and 3 dioptres.

In performing the method of the invention the blank once prepared with the spherical concave back surface may be rotatably mounted with said back surface on a spherical support, the support being rotated about a predetermined axis during the cutting steps, the blank being mounted for forming said first convex lens surface so that the centre of the blank is substantially on the axis of rotation of the support and the support being angularly offset to have its centre of curvature off said axis by an amount defining said first angle and hence said first prismatic component. When mounting the blank on the offset support it is relatively straightforward to ensure that the centre of the front face of the blank is on the axis of rotation of the support. This is achieved by mounting the blank on the support in the usual way using a wax, but rotating the support with the blank in place before the wax is completely set and ensuring that the outer periphery of the blank is substantially symmetrical about the axis, e.g. by gently touching the periphery with a finger as it is rotated on the support. Because the thickness of the blank along the axis of rotation when mounted on the support is relatively small, it can be considered that by this procedure the blank is mounted with its physical centre substantially on the axis of rotation. Therefore, the angle of offset of the support defines said first angle at which the first convex surface is to be cut.

In one example, the position of the blank may be adjusted, before cutting the second surface, by rotating the blank by 180° relative to the support about said axis of rotation. This procedure conveniently sets the blank for cutting the second surface to form said segment with the prismatic component of the segment equal but of opposite sign to the prismatic component of the lens portion formed by cutting the first surface.

Alternatively, the position of the blank may be adjusted, before cutting the second surface, by changing the angular offset of the support to a reduced amount defining said second angle. In this case, the prismatic component of the segment is less than, but, of the same sign as the prismatic component of the first surface. The angular offset of the support may be changed by removing the blank from the support used for cutting said first surface and remounting the blank in a corresponding orientation on a further support having the desired reduced angular offset. Instead, the angular offset support may be changed by adjusting the angular relationship between the support and drive means for rotating the support.

The present invention also envisages bifocal contact lenses produced by the method of the invention as described above.

Specifically, the present invention also envisages a soft bifocal contact lens which is cut and polished from a blank before being hydrated to render it soft, the lens having a spherical concave back surface to fit the eye of the wearer, and a front surface having a first spherical convex lens surface which in association with a back surface provides a distance correction lens with a predetermined prismatic component and a second spherical convex lens surface which in association with a back surface provides a near correction lens segment with a prismatic component substantially equal to but of opposite sign to that of the distance correction lens, said second spherical convex lens surface being cut into the base part only of the prismatic distance correction lens, and the contact lens having a lower edge adjacent said lens segment, which provides a ledge and is truncated to a radius greater than the radius of the blank, so that the contact lens can be stabilised in the eye with the ledge at the lower edge resting on the lower eyelid.

In a preferred embodiment, the second lens surface of said segment has a lower limit spaced from the adjacent said lower edge of the contact lens and there is a thicker portion of the contact lens at said lower edge to provide said ledge. Further, there may be on the front surface of the lens between the lower limit of said segment and the lower edge of the lens a further spherical surface portion having a radius of curvature greater than that of the second lens surface so that the thickness of the contact lens behind the further surface portion increases towards said lower edge.

Examples of the present invention will now be described with reference to the accompanying drawings in which:

Figures 1 and *2* illustrate diagramatically two stages in the process of cutting a bifocal contact lens, showing the lens mounted on the rotatable support of a cutting lathe;

Figure 3 is a vertical section through a finished bifocal contact lens made in accordance with the method illustrated in Figures 1 and 2;

Figure 4 is a front view of the lens of Figure 3;

Figure 5 illustrates a different method of making a bifocal contact lens in accordance with the invention and

Figure 6 is a front view of a complete contact lens made by the method illustrated in Figure 5.

The method of the present invention can be performed using lens cutting lathes such as are commonly used in the art for cutting both hard and soft contact lenses. Suitable precision lathes are the C.L.M. automatic lathes available from Robertson

Engineering Limited. These lathes have a convex spherical support member on which a blank can be mounted after the concave back surface has been cut. The blank with the concave back surface is mounted on the spherical support by means of a wax preparation which firmly holds the blank to the support. The support is then rotated about a predetermined axis at high speed during the process of cutting the front surface of the blank. No further description of the lathes used in performing the method of the present invention will be given herein except insofar as the present method involves modification of the support member of the lathe on which the blanks are mounted.

A normal single power contact lens is mounted for cutting its front surface in accordance with the desired prescription on a spherical support member which has its centre of curvature on the axis of rotation. With the blank mounted on such a support symmetrically about the axis of rotation, a contact lens can be cut which is symmetrical about its central axis and has no prismatic component. In performing the method of the present invention, the desired prismatic components can be produced, using a support having the centre of curvature of its spherical surface on the axis of rotation, by mounting the lens blank on the support asymmetrically relative to the axis of rotation. This method can be employed to cut the first and second spherical surfaces on the front face of the blank in accordance with the steps of the method described previously herein. The blank can be re-positioned after cutting the first surface at a different angle of offset on the spherical support for cutting the second surface to produce the near segment of the lens. However, this process can be very difficult to perform with the desired degree of accuracy for reliably producing lenses according to prescription. Further, this technique permits bifocal contact lenses to be made with only a restricted range of powers.

Accordingly, it is preferred to perform the method of the present invention by offsetting the spherical support surface relative to the axis of rotation so that the centre of the support surface is set off the axis of rotation. Figures 1 and 2 illustrate a preferred example in accordance with this technique. In these Figures, a support 10 forming part of a lens cutting lathe (not shown) has a spherical convex support surface 11 with a centre of curvature 12. The support 10 is rotated by the lathe about an axis 13 during the cutting operation. As shown in Figure 1, the surface 11 is tilted or offset relative to the axis 13 so that the centre of curvature 12 is off the axis 13. This offset of the surface 11 can readily be provided from a standard symmetrical support by making a cut perpendicular of the axis 13 through the support immediately behind the support surface 11 nearly completely through the support, and then bending the portion of the support with the surface 11 inwards to close the cut thereby producing the desired offset. Alternatively, a support may be provided in which the degree of offset can be adjustable by means of replaceable wedges mountable between the main body of the support and the portion having the spherical support surface 11. Any other technique of providing the offset in the spherical support surface 11 may be employed in performing the present invention provided, in the present example, they serve to locate the centre of curvature of the surface 11 off the axis of rotation by a predetermined amount.

As shown in Figure 1, a lens blank 14 is located and fastened on the surface 11. The blank 14 is previously formed with a concave back surface 15 symmetrical about the axis of symmetry of the blank. The concave back surface is formed in the blank in the usual way for the manufacture of contact lenses and is formed so as to fit over the cornea of the eye of the intended wearer of the finished contact lens. The radius of curvature of this back surface is critical and the radius of curvature of the support surface 11 is selected to be substantially the same as that of the back surface of the blank so that the centre of curvature of the surface 15 when the blank is mounted on the surface 11 is substantially at the centre 12.

The blank 14 is mounted on the surface 11 of the support so that the outer periphery of the blank is substantially symmetrical about the axis of rotation 13. The blank 14 is fastened to the surface 11 in the usual way for manufacture of contact lenses by means of a wax which is applied to the surface 11 in molten form before the blank 14 is positioned and then sets to hold the blank firmly in place. The positioning of the blank symmetrically about the axis of rotation 13 can be achieved quite easily by operating the lathe to rotate the support 10 and blank 14 before the wax is completely set, and then adjusting the position of the blank 14 on the support 11 until the outer edge 16 of the front surface of the blank 14 is symmetrical by just touching the edge 16 with a finger. This procedure ideally locates the blank 14 so that the centre of the outer face 17 of the blank lies on the axis 13. In practice the centre of the face 17 will be located very close to the axis 13. Further, because the thickness of the blank 14 along its central axis is relatively small the procedure described above can be said to locate the blank with its physical centre substantially on the axis of rotation, and also with the optical centre of the finished lens substantially on the axis 13.

Having located the blank 14 as described above, a first convex lens surface 18 is cut on the front face of the blank by operating the lathe in the usual way. The radius of curvature of the surface 18 is selected so that in association with the back surface 15 there is produced a lens having a desired distance correction in accordance with the prescription to which the lens is being made. Frequently, though not always, this distance correction will require a positive lens so that the radius of curvature of the surface 18 is made rather less than the radius of curvature of the concave surface 15. In the example illustrated in Figure 1 the centre of curvature of the surface 18 is on the axis of rotation 13 at the point 19.

Because of the offset of the surface 11, the lens produced by cutting the surface 18 has a prismatic component as can clearly be seen in Figure 1, leaving a thicker portion of the lens (the upper portion in Figure 1). The value of this prismatic

component corresponds to the angle 20 between the line from the centre 19 of curvature of the surface 18 to the centre of the blank (the axis 13 of rotation in Figure 1) and the line from the centre 12 of curvature of the back face 15 to the centre of the blank (line 21 in Figure 1). As can be seen by studying Figure 1, the angle 20 is substantially controlled by the angle of offset of the spherical surface 11 of the support 10 relative to the axis of rotation 13. As will become apparent from the following further description, the amount of offset of the surface 11, and hence of the prismatic component of the distance correction lens is determined to provide sufficient material in the thicker portion of the lens after cutting the first surface 18 to enable the desired near correction segment to be cut in this thicker portion. It will be appreciated that it is desirable for the axial thickness of the finished contact lens to be as small as possible both for the comfort of the wearer and to reduce the weight of the contact lens. It is thus desirable to keep the prismatic component when cutting the surface 18 to the minimum value possible which still enables the desired distance correction segment to be provided.

After cutting the surface 18 it may be necessary to polish this surface to provide the desired optical finish.

In order to provide the near correction segment in the contact lens, the blank with the surface 18 is removed from the support surface 11 by heating the support 10 to melt the wax in the usual way. The blank is then remounted on the support surface 11 rotated, relative to the axis of the support 10, by 180°. This reorientation of the blank is illustrated in Figure 2 where the thicker portion of the blank is now at the bottom in the Figure. The blank is again mounted on the surface 11 so that the axial centre of the blank is substantially on the axis 13 of rotation of the support 10. However, the line from the centre 19 of curvature of surface 18 to the centre of the blank is no longer coincident with the axis 13, but is identified in Figure 2 by the reference 22.

Once the blank is repositioned on the surface 11 the lathe can be set to cut a second convex surface on the front face of the blank to form the required near segment. As shown in Figure 2, the near segment also provides a positive correction of a somewhat higher power than the distance correction, so that the radius of curvature of the surface forming the near segment is somewhat less than that of the surface 18. As shown in Figure 2, the lathe is set to cut a surface identified by the reference 23 which has a centre of curvature 24 on the axis of rotation 13. During the process of cutting the surface 23 the lathe tool is fed axially, parallel to the axis 13, only until the cut surface 23 extends to a point 25 slightly below, in Figure 2, the axis 13. Thus, the surface 23 is produced only in the previously thicker portion of the blank leaving the remainder as the distance correction element of the finished lens as defined by the surface 18.

Also, the lathe is controlled to cut radially outwards from the axis 13 only as far as a point 26 at which the lens has a desired minimum thickness. (It can be seen that if the cutting of the surface 23 was continued further outwards, the bottom most part (in Figure 2) of the lens blank would be cut away). As a result, the bottom edge of the blank is left with a thickened portion 27. This portion 27 can serve as a ledge at the bottom edge of the finished contact lens which can enable the contact lens to rest on the lower eyelid of the eye of the wearer. This enables the lens to be deflected in the eye to position the near segment over the pupil by the wearer simply glancing downwards.

However, for most prescriptions, the remaining thickened portion 27, such as shown in ghost in Figure 2, is in excess of that required to provide the ledge and has the disadvantage of making the lens excessively bulky and heavy. Thus, preferably, a further cut is made on the front surface of the blank before removing the blank from the support surface 11. This cut is made with the blank in the same orientation as shown in Figure 2 but with the cutting tool arranged to produce a surface with a radius of curvature much larger than that of surface 23. In the example shown in Figure 2, the centre of curvature of the further surface portion which is identified in the Figure by reference 28, would be well off the drawing at a point on the axis of rotation 13. The cutting tool of the lathe is controlled so that the lens is cut to produce the surface 28 from the lower limit of the surface 23 to the lower edge of the blank thereby leaving a residual thickened portion 31 to form the supporting ledge of the lens.

As can be seen in Figure 2, the surface 23 forms, in association with the back surface 15 of the lens, a near correction segment for the lens which has a prismatic component with the opposite sign to the component of the distance correction portion. Considering the prismatic component of the near segment relative to the central axis of the contact lens, i.e. the line 21, it can be seen that the prismatic component is of substantially equal value, though opposite sign, to that of the distance portion of the lens. The line from the centre 24 of curvature of the surface 23 to the centre of the contact lens, which is the axis of rotation 13 in Figure 2, is at an angle 32 to the central axis 21, and angle 32 is substantially equal to the angle 20.

A finished contact lens made in accordance with the method illustrated in Figures 1 and 2 is shown in Figures 3 and 4. It will be appreciated that after cutting the convex lens surfaces 18 and 23 on the front surface of the blank, it is usually necessary to polish these surfaces to provide the required optical finish. As can be seen from the front view of the finished lens in Figure 4, the near correction segment formed by the surface 23 has the shape of a crescent moon with the upper limit 25 of the segment on the vertical axis 33 of the contact lens somewhat below the horizontal axis 34 of the lens. This distance should be sufficient to enable the pupil 35 of the eye of the wearer of the lens to take up a position as illustrated in ghost in Figure 4 substantially at the centre of the lens to enable vision through the distance correction portion defined by the surface 18.

The upper and lower edges of the contact lens are preferably truncated as illustrated at 36 and 37 in

Figure 4, to have a radius somewhat larger than the radius of the lens blank. The truncated bottom edge 37 effectively removes a portion of the thickened edge portion 31 produced as described above with reference to Figure 2 so that the resulting ledge is as shown at 38 in Figure 3. The combination of the truncated lower edge 37 with the ledge 38 enables the contact lens to rest on the lower eyelid of the wearer. This enables the lens to be correctly positioned in the eye so that the pupil 35 is located on the centre of the lens when the wearer is looking straight ahead. By depressing the eyes, i.e. looking downwards, the wearer causes his eyes to rotate downwards behind the lenses so that the pupil 35 is brought into the near correction segment defined by the surface 23 for, for example, reading. The upper truncated edge 36 also aids in locating the lens on the eye and is preferably arranged so that the upper edge 36 remains just clear of the upper eyelid when the wearer is looking straight ahead.

An alternative method of making a bifocal contact lens in accordance with an example of this invention is illustrated in Figures 5 and 6. According to this method, a lens blank is prepared in the same way as for the method described with reference to Figures 1 and 2 up to the stage of cutting the first convex surface 18 on the front face. The same reference numerals are used in Figure 5 as in Figure 2 to identify the centre 12 of curvature of the back surface 15 of the blank, the central axis 21 of the blank and resulting contact lens, the centre 19 of curvature of the surface 18 and the line 22 from the centre 19 to the centre of the lens. As shown in Figure 5, the surface 18 is cut in the same way as for the arrangement of Figure 1 so that the line 22 is at an angle 20 to the line 21. Thus, the surface 18 in association with the back surface 15 provides a positive correction lens with a prismatic component defined by the angle 20.

The lens is shown in Figure 5 mounted on a support surface 11 arranged for cutting a second convex surface 39. In this arrangement, the lens is mounted on the support 11 in the same orientation as for cutting the first surface 18, but for the second surface the support surface 11 is arranged to have a reduced offset relative to the axis 13 of rotation of the support. This may be achieved either by removing the lens blank after cutting the surface 18 from the support 11 used for making this cut and remounting the blank in a corresponding orientation on a second support of which the support surface has a reduced offset as required. Alternatively, the same support may be employed and the offset of the support surface 11 may be adjusted, for example by incorporating a different size of wedge element between the portion of the support having the support surface 11 and the rest of the support.

The second surface 39 is arranged to provide a near correction segment for the lens and therefore has a somewhat smaller radius of curvature compared with the surface 18. The centre of curvature of the surface 39 is identified in Figure 5 by the point 40 on the axis of rotation 13. As can been seen in Figure 5, the line from the centre 40 to the centre of the lens is at an angle 41 to the central axis 21 of the lens, angle 41 being less than the angle 20, although of the same sign. Thus, the near correction segment comprising the surface 39 in association with the back surface 15 of the lens has a prismatic component which is less than but of the same sign as the prismatic component of the distance correction portion of the lens defined by the surface 18.

As with the example of Figures 1 and 2, the surface 39 is cut into the thicker portion only of the prismatic lens formed when cutting the surface 18 and extends from the thick edge 42 of the lens to a point 43 somewhat short of the centre of the lens.

With this arrangement, it can be seen that cutting the two surfaces 18 and 39 leaves a flat ledge at the thicker edge 42 of the finished lens. This flat portion enables the finished bifocal contact lens to be stabilised in the eye in the manner described in connection with the previous example. However, the example of Figures 5 and 6 can usually only be employed for making contact lenses of relatively low corrective powers. Furthermore, the central thickness and overall weight of the finished lens tends to be somewhat larger than lenses made in accordance with the last example.

Figure 6 provides a front view of a lens made as illustrated in Figure 5. The lens in Figure 6 is shown in the correct orientation with the thicker edge 42 at the bottom. As with the last example, the finished lens is preferably truncated at the top and bottom to provide a relatively flat lower and upper edges for stabilising the lens in the eye with the pupil 44 substantially on the centre of the lens behind the distance correction portion defined by the surface 18 when the wearer is looking straight ahead.

In a specific example of a bifocal lens made in accordance with the method described with respect to Figures 1 and 2, both the distance correction portion and the near correction segment of the lens have prismatic components of about 2 dioptres but of opposite sign.

In a specific example of a bifocal contact lens formed by the method described with respect to Figure 5, the prismatic component of the distance correction portion of the lens is approximately 5 dioptres and that of the near correction segment between 2 and 3 dioptres and of the same sign.

CLAIMS

1. A method of manufacturing a bifocal contact lens of a soft plastics material using a blank which is cut and polished before hydrating to render it soft, comprising the steps of cutting and polishing the back face of the lens blank to form a spherical concave surface, rotatably mounting the blank for cutting the front surface with rotation of the blank about a predetermined axis to form a first convex lens surface with the line from the centre of curvature of this surface to the centre of the blank being at a first angle to the line from the centre of curvature of the back face to said centre so that the resulting lens has a first prismatic component, cutting the front surface to form said lens, adjusting the position of the blank relative to the axis of rotation to set it for forming a second spherical convex lens surface on

the front face with the position of the blank such that the line from the centre of curvature of the second convex surface to said centre of the blank is at a second angle to the line from the centre of curvature of the back face to said centre of the blank so that said second lens surface can be formed over a thicker part only of said lens and form a lens segment having a second prismatic component, said second angle being smaller than or of opposite sign to said first angle so that said second prismatic component is smaller than or of opposite sign to said first component, and then cutting said second spherical convex lens surface over said part of the front surface to form said segment and subsequently hydrating the blank to render it soft.

2. A method as claimed in claim 1, wherein said lens segment provides a near segment for the contact lens and the contact lens is formed so that its lower edge adjacent said lens segment provides a ledge and is truncated to a radius greater than the radius of the blank, so that the contact lens can be stabilised in the eye with the ledge at the lower edge resting on the lower eyelid.

3. A method as claimed in claim 2, wherein said first and second angles are substantially equal and of opposite sign so that said first and second prismatic components are of substantially equal value but opposite sign.

4. A method as claimed in claim 3 where said second spherical convex lens surface is cut into said thicker part of said lens so that the lower limit of the second surface is spaced from the adjacent lower edge of the blank and a thicker portion of the contact lens is formed at the lower edge thereof to provide said ledge.

5. A method as claimed in claim 4 wherein there is a further step of cutting a further spherical surface portion on said front surface between said lower limit of the second surface and the edge of the blank with the radius of curvature of said further surface greater than the radius of said second surface so that the thickness of the contact lens behind said further surface increases towards said lower edge leaving said thicker portion of the contact lens at the lower edge thereof.

6. A method as claimed in any of claims 3 to 5, wherein said first and second surface are cut to have prismatic components of opposite sign and not greater than 5 dioptres.

7. A method as claimed in claim 6, wherein the prismatic components are not greater than 3 dioptres.

8. A method as claimed in claim 7, wherein the prismatic components are about 2 dioptres.

9. A method as claimed in claim 2, wherein said second angle is less than said first angle but of the same sign, i.e. on the same side of the line from the centre of curvature of the back face to the centre of the blank, so that said second prismatic component is less than but of the same sign as said first component.

10. A method as claimed in claim 9, wherein said first prismatic component is about 5 dioptres and said second component is between 2 and 3 dioptres.

11. A method as claimed in any preceding claim wherein the blank with the spherical concave back surface is rotatably mounted with said back surface on a spherical support, which support is rotated about a predetermined axis during the cutting steps, the blank being mounted for forming said first convex lens surface so that the centre of the blank is substantially on the axis of rotation of the support and the support being angularly offset to have its centre of curvature off said axis, by an amount defining said first angle and hence said first prismatic component.

12. A method as claimed in claim 11 as dependent on any of claims 3 to 8 wherein the position of the blank is adjusted, before cutting the second surface, by rotating the blank by 180° relative to the support about said axis of rotation.

13. A method as claimed in claim 11 as dependent on claim 9 or claim 10 wherein the position of the blank is adjusted, before cutting the second surface, by changing the angular offset of the support to a reduced amount defining said second angle.

14. A method as claimed in claim 13, wherein the angular offset of the support is changed by removing the blank from the support used for cutting said first surface and remounting the blank in a corresponding orientation on a further support having the desired reduced angular offset.

15. A method as claimed in claim 13, wherein the angular offset of the support is changed by adjusting the angular relationship between the support and drive means for rotating the support.

16. A method of manufacturing a bifocal contact lens of a soft plastic material substantially as hereinbefore described with reference to the accompanying drawings.

17. A soft bifocal contact lens made by the method of any of the preceding claims.

18. A soft bifocal contact lens which is cut and polished from a blank before being hydrated to render it soft, the lens having a spherical concave back surface to fit the eye of the wearer, and a front surface having a first spherical convex lens surface which in association with the back surface provides a distance correction lens with a predetermined prismatic component and a second spherical convex lens surface which in association with the back surface provides a near correction lens segment with a prismatic component substantially equal to but of opposite sign to that of the distance correction lens, said second spherical convex lens surface being cut into the base part only of the prismatic distance correction lens, and the contact lens having a lower edge, adjacent said lens segment, which provides a ledge and is truncated to a radius greater than the radius of the blank, so that the contact lens can be stabilised in the eye with the ledge at the lower edge resting on the lower eyelid.

19. A lens as claimed in claim 13 wherein the second lens surface of said segment has a lower limit spaced from the adjacent said lower edge of the contact lens and there is a thicker portion of the contact lens at said lower edge to provide said ledge.

20. A lens as claimed in claim 19 wherein there is on the front surface of the lens between the lower

limit of said segment and the lower edge of the lens a further spherical surface portion having a radius of curvature greater than that of the second lens surface so that the thickness of the contact lens behind the further surface portion increases towards said lower edge.

21. A soft bifocal contact lens substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

Printed for Her Majesty's Stationery Office by Croydon Printing Company Limited, Croydon Surrey, 1980.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.